DEFENSE NUCLEAR FACILITIES SAFETY BOARD

March 19, 1993

MEMORANDUM FOR: G.W. Cunningham, Technical Director
W.R. Kornack, Director, Engineering Group
A.G. Stadnik, Director, Materials Processing Group

COPIES: Board Members

FROM: David C. Lowe

THROUGH: Dermot Winters, Idaho Team Leader

SUBJECT: Idaho Chemical Processing Plant (ICPP) Trip Report (March 4, 1993)

1. **Purpose:** This trip report documents the Defense Nuclear Facilities Safety Board (DNFSB) technical staff and outside expert March 4, 1993 review of ICPP chemical and waste processing plans. DNFSB technical staff included David Lowe and Dermot Winters, and outside expert Dr. Joseph Leary (TRU Engineering Company, Inc.).

2. **Summary:** A summary of the DNFSB staff review team's major conclusions are provided below:

a. Westinghouse Idaho Nuclear Company (WINCO) does not appear to be giving adequate attention to established and effective alternative process flowsheets for dealing with the sodium wastes, such as the precipitation/ion exchange flowsheet. The current WINCO program is to proceed with diluting the sodium wastes with aluminum nitrate and calcining. This process will achieve little or no volume reduction. The current focus of the alternative technologies program is to study undeveloped technologies that may support long-term processing alternatives for the sodium wastes.

b. There is inadequate Department of Energy (DOE) coordination and technology exchange between the various DOE sites that have major decontamination and decommissioning (D&D) commitments.

3. **Background:** The Idaho Chemical Processing Plant (ICPP) is operated for the DOE by WINCO. The ICPP ceased reprocessing of Navy reactor fuel in late 1991. There are plans to restart 2nd and 3rd cycle solvent extraction and denitrator operations for brief periods in order

to process existing "in-process" materials. After that effort, flushing and decontamination activities of process facilities are planned. Additionally, there are several million gallons of radioactive waste (sodium, fluorinel, and aluminum wastes) stored in the tank farm that must be processed.

4. Discussion: The DNFSB review consisted of DOE-ID and WINCO technical briefings and discussions, and document reviews.

a. Sodium Waste Processing Plans: Currently there is about 1.5M gallons of sodium waste in six 300,000 gallon tanks. The sodium wastes were generated primarily from decontamination activities and have high concentrations of sodium and potassium. An additional 2M-6M gallons of sodium wastes may be generated as part of the planned decontamination of the ICPP if alternative decontamination methods are not developed. The sodium waste is considered transuranic (TRU) waste because TRU concentrations are greater than the Level C TRU limits of 10 CFR Part 61. If the TRU was removed, the range of activity concentrations would probably classify this waste as Class C low-level waste as defined in 10 CFR Part 61.

Under a Consent Order between DOE, the State of Idaho, and WINCO, WINCO has to remove the waste from the "pillar and post" tanks by 2009, and from the remaining tanks by 2015 because of failure to meet Resource Conservation and Recovery Act (RCRA) requirements. In the past, the sodium waste was blended with other waste types prior to calcination. However, currently there is only enough fluorinel and aluminum waste to support mixing with about 50,000 gallons of sodium waste which will then be calcined. WINCO is developing a new process wherein aluminum nitrate is added to the sodium waste to dilute the sodium and potassium concentrations, and then this blend is calcined. At present the sodium and potassium concentration that can be calcined is uncertain, varying from 5.4 to 11.7 mole %. An important shortcoming of this approach is that the waste volume reduction obtained from calcination will be small and may be zero.

A key parameter in the calcination process is the concentration of sodium and potassium. Calcination of the sodium wastes by itself has been deemed unsuitable due to the low melting points of sodium and potassium salts (307°C and 334°C, respectfully) and the high temperatures required for calcination (approximately 500°C). These two factors contribute to agglomeration of the salts in the bed of the calciner which severely hinders calciner operation and future calcine storage.

Several alternative processing and flowsheet options have been identified and prioritized, and some are being tested and evaluated against the sodium waste/aluminum nitrate calcination baseline. The alternative process technologies range from established process methods to processing concepts that are only at a laboratory scale. The thrust of the FY-1993 WINCO effort is laboratory scoping studies on four process technologies (electrohydrolysis for sodium removal, freeze crystallization for sodium nitrate separation, polymerized crown ether sorption of sodium, and crown ether extraction of cesium and strontium) that are early in the development cycle.

The best alternative flowsheet appears to be neutralizing the acidic waste which will precipitate the TRU and much of the Sr-90, followed by ion exchange to remove Cs-137 if the activity levels warrant further reduction to meet 10 CFR Part 61 requirements for shallow-land disposal. The decontaminated solution would then be grouted as low-level waste, and the more radioactive waste streams (sludge and ion exchange raffinate) would either be processed to a vitrified waste form directly or redissolved with acid and then calcined. This flowsheet would appear to provide several significant benefits over the baseline case and the flowsheet alternatives that are the focus of the WINCO alternative technology program. Some of these benefits are:

- Use of existing and proven process technologies to remove the TRU, the majority of the Sr-90, and the Cs-137 (if required).

- Substantial reduction in the volume of calcine and future vitrified waste forms.

- Use of existing and proven technologies to immobilize the resulting low-level liquid waste streams in accordance with 10 CFR Part 61.

- Ability to process the sodium wastes in a timely manner which should meet all State agreements and federal regulations.

- Potential for substantial cost savings and technical risk reduction.

WINCO does not appear to be giving the precipitation/ion exchange flowsheet adequate attention, especially since the basic process technologies are well developed and proven to be effective.

b. Alternative Decontamination Methods: Under present D&D plans there will be an additional 2M-6M gallons of sodium waste generated in the future. Therefore, WINCO has started a program to evaluate alternative decontamination methods, ranging from laboratory demonstration technologies (e.g., light ablation) to fairly well established technologies (e.g., CO_2 pellet blasting). Major milestones in the test plan for FY-1993 include cold testing of light ablation, water grit blasting, and CO_2 pellet blasting. The plan seems to be reasonable.

There is inadequate coordination and technology exchange between the various DOE sites that have major D&D commitments. WINCO personnel stated that they only learn of experiences at other sites by making visits and by attending various technical meetings, but there is not a DOE sponsored D&D technology exchange group for DOE site contractor representatives. It would be appropriate for DOE to establish such a group considering the changes in the DOE mission.

c. Chemical Processing Plans: The ICPP processing of fuel was shutdown in November 1991. The denitrator, which is used to convert uranyl nitrate solution to uranium trioxide, was shut down in July 1991 because of technical standard violations which have been corrected. The ICPP process is now transitioning to D&D, with in-process material processing and cleanout

operations planned for 2nd and 3rd cycle solvent extraction and the denitrator. Currently, these operations are planned to start in October 1993 and be completed by July 1994. Procedure walk-downs are scheduled to start in June 1993. WINCO is developing an ORR plan, but DOE-ID ORR plans are still unclear. The WINCO and DOE ORR plans were requested and the DNFSB staff will follow this issue.